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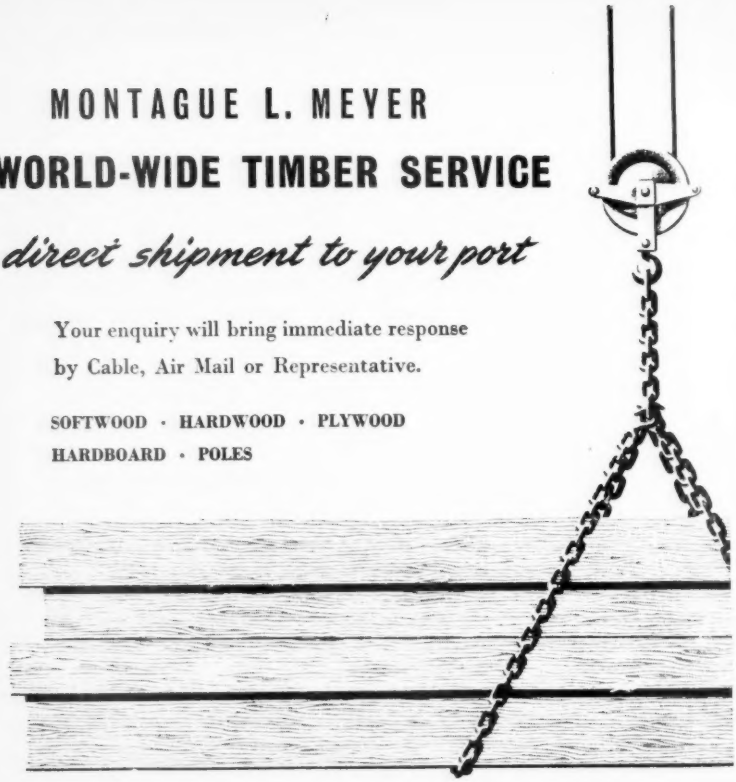

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CONTENTS

THE REDWOOD LECTURE 373
OWNERSHIP OF WORLD OIL PRODUCTION 376
MODERN TECHNIQUES IN PETROLEUM TESTING. IV. ENGINE TESTS OF AVIATION FUELS BY J. OGLE AND C. H. SPRAKE 377
AROUND THE BRANCHES 385
FAWLEY REFINERY OPENED 387
WORLD PETROLEUM STATISTICS, 1950 399
FORTHCOMING MEETINGS 404

THE REDWOOD LECTURE

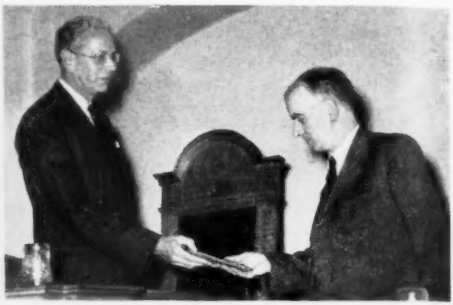
On October 3 the Redwood Medal of the Institute of Petroleum was presented to Professor F. H. Garner, O.B.E., M.Sc., Ph.D., a past-president of the Institute, its honorary editor, and director of the Department of Chemical Engineering at the University of Birmingham.

The chair was taken by M. A. L. Banks, vice-president, in the absence abroad of the president. A large number of members and guests were in attendance including three previous recipients of the Redwood Medal—W. H. Fordham (1927-9), Dr A. E. Dunstan (1938), and H. S. Gibson, C.B.E. (1948).

Prior to receiving the medal, Professor Garner delivered the Redwood Lecture, his subject being "The training of a technologist." He said that most scientists would agree that some knowledge of the humanities should be included in their training, but by no means all humanists consider that a knowledge of science should figure in theirs, although a man without some understanding of scientific methods and achievements suffers a serious impoverishment in his whole intellectual life.

In addition to some knowledge of the arts, the applied scientist, the technologist, needs special personal qualities of leadership which can only be gained by personal contact rather than through books.

Referring to the feeling current to-day that recent developments in science have endangered mankind's future and that this is in some way connected with the deficiencies in training and outlook of scientists, Professor Garner said that the results of scientific discovery can be applied well or ill and it is the standard of intelligence and moral standards of the whole of the educated communities, not those of the scientists alone, which



Professor Garner (left) *reading the Redwood Lecture and* (below) *receiving the Medal from Mr M. A. L. Banks*

form the decisions. Moreover, until the last fifty years, had not the whole of the British educational system been inspired and conducted by those trained in the humanities? And the result of such training through hundreds of years is now said to be that the educated section of the community is unfitted to deal with to-day's problems.

Considering the broader aspects of training, Professor Garner refuted the idea current in some quarters that applied sciences are out of place in a university and that modern engineering education consists of a series of snippets of subjects with no real grounding in any branch of science whatever. Some thought that engineers should be taught only applied mathematics, modern physics and recent advances in chemistry for three years and learn engineering in a graduate course. But surely the assumption that everything labelled "mathematics," "physics," or "chemistry" was basic or fundamental was wrong. It is a fallacy to assume that knowledge can be allocated into boxes when in point of fact there is an immense borderline, such as for example physical chemistry, which is taught in chemistry departments but might equally well be taught in physics departments.

After the Redwood Lecture Professor Garner was entertained at dinner by the Council. He is seen here with the two other Redwood Medallists who attended: (left) *H. S. Gibson, C.B.E., and* (right) *W. H. Fordham*

Discussing the factors necessary for a successful university training, Professor Garner considered that the technologist requires a fuller series of lectures, tutorials, and practical classes than is necessary for an arts student and these must be so directed that they lead to the development of the potentialities of the personalities of individual students.

The "know-how" of industry can only be acquired in industry itself, but the teaching of why different techniques are used and the principles on which they are based can well be taught at the university. Contact with industry at home and abroad should be maintained through vacation courses.

Professor Garner concluded by expressing the hope that graduate schools, so long an integral part of technological training in the United States, might soon be firmly established in Britain.

Presenting the Medal to Professor Garner at the conclusion of the lecture, Mr M. A. L. Banks referred to the long and valued service which Professor Garner had given, not only to the industry as a whole but also to the Institute.

At the conclusion of the meeting, the Redwood Medallist was entertained to dinner by members of Council, the chair at this event being taken by H. S. Gibson, C.B.E.

★ ★ ★

PERSONAL NOTES

Captain G. P. Claridge, R.N.(Ret), has been appointed Chief Executive of the C.B.M.P.E.

T. G. Crane has been elected managing director of Monsanto Chemicals (Australia) Ltd. in place of Dr James H. Lum, who is returning to the U.S. to take up other duties with Monsanto Chemicals Ltd. A new director of Monsanto Chemicals (Australia) Ltd., is Dr **Charles A. Thomas,** who has taken the place of William M. Rand, who recently retired.

A. J. Haworth, F.Inst.Pet., has been elected president for 1951-52 of the Eastern Section of the American Association of Petroleum Geologists.

★ ★ ★

After Dr M. Muskat read his paper on "Our unproduced reserves: what are they?" on September 19 he was entertained to dinner. He is seen here with E. C. Masterson (left), Dr G. M. Lees (right centre), and H. S. Gibson, C.B.E. (right)

BEILBY MEMORIAL AWARDS

British investigators who wish to be considered for awards from the Beilby Memorial Fund during 1952 are reminded that applications should be addressed to the Administrators, Sir George Beilby Memorial Fund, Royal Institute of Chemistry, 30 Russell Square, London, W.C.1, not later than December 31 next.

Preference is given to investigations relating to fuel economy, chemical engineering, and metallurgy, and, in general, awards are granted to younger men rather than to workers of established repute.

★ ★ ★

1950 OWNERSHIP OF OIL PRODUCTION

Figures compiled by Petroleum Information Bureau show the extent to which American, British, and British/Dutch interests predominated in world oil production in 1950. Apart from U.S.A. domestic production (290 million metric tons), U.S. oil companies produced more than 100 million metric tons overseas. British and British/Dutch companies accounted for 87 million metric tons (exclusive of their U.S. output)—representing an increase of 18 per cent above their corresponding 1949 output and 34 per cent of all oil recovered outside the U.S.A.

In the Middle East, British and British/Dutch companies supplied almost 47 million metric tons and U.S. companies just over 39 million metric tons. In the Caribbean, where the chief producing country is Venezuela, American companies furnished more than 57 million metric tons and British and British/Dutch companies yielded some 30 million metric tons. In the Far East—mainly from Indonesia and British Borneo—British and British/Dutch output was about 8½ million metric tons. Thus, between them, American, British and British/Dutch interests produced approximately 480 million metric tons—or 88 per cent of the world's 1950 output of 543 million metric tons.

OWNERSHIP OF WORLD OIL PRODUCTION, 1950

(thousands of metric tons)

	British & British/Dutch	U.S.	Total including others
NORTH AMERICA			
U.S.A.	12240	277950	290190
*Canada	neg'ble	2330	3880
Total	12240	280280	294070
LATIN AMERICA			
Venezuela	25100	52390	78140
Mexico	—	—	10490
Colombia	1570	3280	4850
Argentina	490	375	3460
Trinidad	2910	35	2980
Peru	410	1620	2050
Others	360	—	580
Total	30840	57700	102550
MIDDLE EAST			
Persia	32260	—	32260
Saudi Arabia	—	26620	26620
Kuwait	8645	8645	17290
Iraq	3360	1490	6650
Egypt	1780	590	2370
Qatar	780	390	1640
Bahrein	—	1510	1510
Others	—	—	80
Total	46825	39245	88420
FAR EAST			
Indonesia	3650	2800	6450
British Borneo	4240	—	4240
Others	600	160	1140
Total	8490	2960	11830
WESTERN EUROPE			
Germany	60	180	1120
Netherlands	350	350	700
Others	50	4	160
Total	460	534	1980
†U.S.S.R. & EASTERN EUROPE			
U.S.S.R.	—	—	37500
Roumania	—	—	4100
Austria	—	—	1600
Others	—	—	1230
Total	—	—	44430
WORLD TOTAL	98855	380719	543280

*Owing to rapid development of Canadian oil resources, and very large number of companies operating, proportion of output supplied by U.S., Canadian, and other interests is constantly changing.

†Best available estimates. British, British/Dutch and American interests have concessions in Eastern Europe, but at present have no real control over production.

MODERN TECHNIQUES IN PETROLEUM TESTING

IV. ENGINE TESTS OF AVIATION FUELS

By J. OGLE* and C. H. SPRAKE† (Fellow)

Aero engines are normally called upon to operate at substantially constant loads for long periods whereas automotive engines, under normal conditions of operation, are seldom required to develop full power continuously for many minutes at a time. Under cruising conditions the latter are for the most part developing a much smaller proportion of their potential full power than is the case with cruising aircraft.

When detonation or "knock" develops in an engine it may, if allowed to persist, increase in intensity and lead to serious overheating of various parts of the engine, causing loss of power, damage, or even total failure. In the case of the automotive engine a driver can, to some extent, reduce detonation by easing the throttle, changing to lower gear on hills, etc., and although it is desirable in every way that automotive fuels should not detonate under any normal conditions of operation, freedom from knock in the case of the aero engine under conditions of both full power and cruising is of vital importance.

Before the war, tests to determine the anti-knock value of an aviation gasoline were confined to determinations by the CFR Motor Method or the U.S. Army Aviation Method, the results being expressed simply in terms of octane number. These ratings were essentially a measure of anti-knock performance at weak mixtures similar to those used under cruising conditions and were considered to be all that were required for assessing the detonation limited performance of fuels in aero engines.

*Ministry of Supply.
†Esso Development Co.

With the intensive fuel and engine development which took place immediately before and at the beginning of the war, the limitations of the existing fuel rating techniques were soon realized in the U.K. It became apparent that the relative anti-knock performance of fuels of similar weak mixture rating might vary considerably at richer mixture strengths; in other words the Motor or Aviation Method octane number of a fuel was a measure of its anti-knock value at weak mixture strengths only and gave little indication of its potential performance at the much richer mixture strengths used in the aero engine when maximum power was required for take-off and other conditions of rich mixture operation. It was, therefore, found to be necessary to specify the anti-knock performance of fuels both at weak and rich mixture strengths and to evolve a suitable test method to determine rich mixture ratings. The satisfactory development of such a test method has undoubtedly been the most important advance in fuel rating technique during the last decade.

Development of Rich Mixture Rating Test Methods

Fig. 1 illustrates typical complete mixture response curves where power at incipient detonation is plotted against mixture strength or specific fuel consumption. "Weak" and "rich" mixtures are values relative to the theoretical mixture strength required for complete combustion, which varies with the carbon/hydrogen ratio of the fuel. Theoretical mixture strength with normal aviation gasolines is generally between 14½-15 to 1 air fuel ratio.

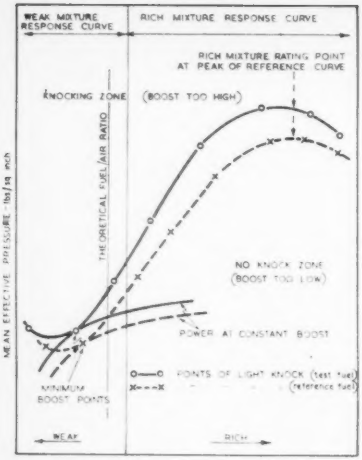

WEAK MIXTURE RESPONSE CURVE
RICH MIXTURE RESPONSE CURVE
RICH MIXTURE RATING POINT AT PEAK OF REFERENCE CURVE
KNOCKING ZONE (BOOST TOO HIGH)
THEORETICAL FUEL/AIR RATIO
MEAN EFFECTIVE PRESSURE lbs/sq inch
NO KNOCK ZONE (BOOST TOO LOW)
POWER AT CONSTANT BOOST
POINTS OF LIGHT KNOCK (test fuel)
(reference fuel)
MINIMUM BOOST POINTS
WEAK
RICH

Fig. 1

Initial investigations to determine the variations of knock limited power with mixture strength were made in Britain on various types of full scale single cylinder engines in order that possible complications introduced by the effects of other physical properties of multi-cylinders might be avoided. The engines used were the Bristol Pegasus and Rolls Royce Kestrel representing air and liquid cooled poppet valve types respectively, and the Bristol Hercules which was air cooled and employed sleeve valves.

Many fuels of various types were tested on these engines, the performance of each being compared with that of a reference fuel known as British Air Ministry 100 octane Reference Fuel (B.A.M.100). This fuel was a segregated batch of 100 octane base fuel to which was added 4.0 ml of tetraethyl lead per I.G.

The rich mixture rating of a fuel was calculated from the power it developed at the specific fuel consumption corresponding to that at which the reference fuel peaked, and was expressed as a percentage of the peak power obtained on the reference fuel (see Fig. 1).

i.e. Rich Mixture Rating =

$$\frac{\text{B.M.E.P. of Test Fuel at S.F.C. at Ref: Fuel peak}}{\text{B.M.E.P. of Ref: Fuel at peak}} \times 100$$

The investigation showed clearly that the octane number of a fuel determined at the mixture strength producing maximum knock, as determined by the CFR "Motor" and "Aviation" test methods bore little relation to the full scale cylinder rich mixture rating. There was however very close correlation between the rich mixture ratings obtained on the different types of single cylinder full scale engines.

In the early days of the war a separate clause was included in U.K. fuel supply contracts specifying a certain rich mixture requirement on Pegasus or Hercules single cylinder units, and in 1942 a rich mixture rating clause was introduced in the U.K. specification for 100 octane fuel requiring the rating to be not less than that of B.A.M.100 control fuel when tested on the single cylinder Hercules running at the specified test conditions (shown in Table I).

Full scale single cylinder test units such as those described were very costly as the equipment required included large capacity air compressors for the supply of considerable quantities of high pressure air for boosting and loading gear of considerable size for the absorption of the high power developed, which in the case of the Hercules single cylinder might be in the region of 150 b.h.p.

Fuel requirements also were high, as for each mixture response curve determined a minimum of 10 gallons was required. For these reasons the full scale single cylinder engine was most unsuitable as a normal test unit for routine inspection work although for some time it was so employed.

TABLE I.

COMPARISON OF ENGINE CONDITIONS FOR FUEL RATING TEST METHODS

Method of Test	*Rich Mixture Test Methods*		*Weak Mixture Test Methods*			
	Hercules	*CRC-F4 (AFD.3-C)*	*Motor (CRC-F.2)*	*25° Motor*	*U.S. Army*	*CRC-F.3 (AFD.1-C)*
Engine	Hercules S/C	Modified CFR	CFR	CFR	Modified CFR	Modified CFR
Capacity (cu. in.)	168.6	37.3	37.3	37.3	24.4	37.3
Speed r.p.m.	2400	1800	900	900	1200	1200
C.R.	7.5:1	7.0:1	Variable	Variable	Variable	Variable
Spark Adv. B.T.D.C.	16	45	19-26 Varied with C.R.	25	30	35
Coolant	Air	Ethylene Glycol—Water	Water	Water	Ethylene Glycol—Water	Ethylene Glycol
Coolant temp. °F.	500*	375	212	212	330	374
Inlet air temp. F.	230	225	75-125	75-125	Atmospheric	125
Mixture temp. F.	—	—	300	300	No heat	220
Mixture strength	Varied with boost pressure	Varied with boost pressure	Adjusted for max knock	Adjusted for max knock	Adjusted for max thermal plug temp	Adjusted for max thermal plug temp
Knock measurement by	Aural or knock meter	Aural or knock meter	Bouncing pin	Bouncing pin	Thermal plug	Thermal plug
Induction system	Supercharged	Supercharged	Normally aspirated	Normally aspirated	Normally aspirated	Normally aspirated
Valve type Inlet	Sleeve	—	Shrouded	Shrouded	—	—
Exhaust	Sleeve	Sodium cooled	—	—	Sodium cooled	—

*Cylinder head temperature measured by thermocouple in standard position.

SMALL-SCALE LABORATORY TEST UNITS (RICH MIXTURE)

It will be clear from the foregoing that a rich mixture test procedure was urgently required for routine test work which would be less costly to instal and operate and attempts were made in the early days of the war to develop such a method. These attempts were naturally focused on the well-established ASTM-CFR engine which was widely available.

A great deal of co-operative work was undertaken to determine operating conditions which would give results correlating satisfactorily with those obtained on the single cylinder full scale units. The general procedure used was similar to that on the larger units in that mixture response curves were determined at a fixed compression ratio with varying boost and mixture strength, and ratings were expressed in terms of knock limited power output as previously described. After the incorporation of various modifications to the engine unit, operating conditions were established which gave ratings in very fair agreement with Pegasus ratings on a wide variety of fuels.

In 1940 American laboratories which were interested in the supply of 100 octane gasoline to the British market were invited to co-operate in the British supercharged CFR engine test programme and supplies of the Air Ministry correlation test fuels were sent to the U.S.A.

Some American laboratories had already been experimenting on supercharged CFR engines although not specifically on rich mixture ratings, and they initially used the "Army Aviation Method" $2\frac{5}{8}$-inch bore cylinder instead of the standard $3\frac{1}{4}$-inch bore normally used on the CFR engine.

It was later found that the boost pressures required were lower than at first contemplated and an intensive programme of work in which the larger bore cylinder was used, was put in hand under the direction of the CFR-AFD Committee.

This work culminated in the introduction of the AFD-3C Supercharge method in 1941.

In this test procedure it was originally intended to determine both "weak" and "rich" ratings. Complete fuel response curves were obtained which were plotted in terms of i.m.e.p. *vs* fuel/air ratio.

The reference fuels were blends of *n*-heptane/*iso*-octane or *iso*-octane with various concentrations of tetraethyl lead and test fuels were bracketed between two of these reference fuels. Ratings of the test fuels were interpolated and expressed either as octane numbers if below 100 or as ml tetraethyl lead U.S.G. in *iso*-octane if above 100.

It was proposed that weak mixture ratings should be determined at the fuel/air ratio corresponding to the "minimum boost point" of the test fuel, which generally occurs at approximately 0.06 : 1, and is that point on the mixture response curve at which the boost pressure required to produce knock is lower than at any other point on the curve (see Fig. 1). The rich mixture rating it was proposed, should be determined at a fuel/air ratio 50 per cent richer, i.e. at approximately 0.09: 1.

After considerable experience in the use of this method it was found to be unsatisfactory due to the tendency towards instability at mixture strengths around the minimum boost point.

In consequence the location of the "minimum boost point" was difficult to determine and this fact rendered the definition of the fuel/air ratio for rich mixture rating uncertain.

These difficulties led to the decision that the test method should be used for the determination of rich mixture ratings only, the rating being determined at the fuel/air ratio corresponding to the peak of the lower bracketing reference fuel.

A rich mixture rating requirement by this test method was first introduced in the U.S. Army-Navy gasoline specifications in 1942, and since that time the method has, with minor modifications only, been in use continuously. Changes in the co-ordinating bodies since that time in the U.S.A. have led to many changes in the designation of test methods generally and the AFD-3C test method described has for some time past been designated as the CRC-F.4 method.

The method was adopted also in the U.K., standardization with the U.S. being of great importance. In the light of experience gained during the development of the Hercules and Pegasus test methods it was decided, however, to adopt certain modifications to the U.S. technique as follows:—

The complications entailed in measuring air flow were considered to be unwarranted and mixture response curves were plotted on the basis of specific fuel consumption instead of fuel/air ratio.

The use of a single reference fuel was retained, and in order to obviate the weathering difficulties experienced with BAM.100 control fuel, *iso*-octane plus 1.28 ml of tetraethyl lead per U.S. gallon, which had the same rich mixture rating, was adopted as the standard reference fuel.

Rich mixture ratings were expressed as a percentage of the peak power obtained on this reference fuel in a similar manner to the previously described method used in the full scale single cylinder test methods.

This method of expressing ratings had the advantage that relative performance of fuels in a main aero engine were thereby indicated.

Ratings by the CRC-F.4 method with the modifications described were included in British specifications in 1943 and this method of test has remained in use until the present time.

The U.S. Army-Navy (A.N.) Performance Number Scale

When fuel ratings are expressed in terms of matching reference fuel blends they give no indication of relative engine performance and to overcome this drawback the Performance Number scale was introduced in the U.S.A.

The scale is based on the ratio of the knock limited peak power obtained on a given reference fuel blend to that obtained on *iso*-octane; the latter being assigned a performance number of 100. These ratios were averaged for a number of full scale and laboratory F.4 test engines, and the performance number scale was constructed from the data so obtained. Table II shows the relationship between mls T.E.L/U.S.G. in *iso*-octane and performance number.

TABLE II

Performance No.	ml T.E.L/U.S.G. in *Iso*-octane
100	0.00
105	0.13
110	0.28
115	0.47
120	0.69
125	0.96
130	1.28
135	1.68
140	2.17
145	2.78
150	3.54
155	4.50
160	5.71

The scale is analogous to the U.K. rich mixture rating scale, the reference point in the U.K. scale being *iso*-octane plus 1.28 ml T.E.L/U.S.G. (A-N Perf. No. 130).

A general relationship between the scales is however established as the average peak i.m.e.p.'s of the reference fuel blends of *n*-heptane/*iso*-octane and *iso*-octane/T.E.L. have been determined on a large number of F.4 test engines, thus enabling performance numbers to be converted to U.K. rich mixture ratings and vice versa. The performance of individual test engines may however vary to some slight degree and some error in converting individual ratings from one scale to the other may result.

The relationship between performance number and blends of reference fuels has been determined below 100 octane number as well as above 100 octane number but in practice the use of performance numbers is generally confined to fuels rating above 100.

Performance numbers and octane numbers are used for "weak" and "rich" ratings. Two examples will make this point clear.

A fuel designated as a 91/98 grade is equal to 91 octane under weak mixture conditions, and to 98 octane number under rich mixture conditions of test, whereas a fuel designated as a 115/145 grade is equal to *iso*-octane plus 0.47 ml T.E.L/U.S.G. (115 performance number) under weak conditions and to *iso*-octane plus 2.78 ml T.E.L/U.S.G. (145 performance number) under rich mixture conditions of test.

Although based solely on rich mixture performance, performance numbers are for the sake of convenience applied also to the expression of weak mixture ratings as shown above, the same conversion being used.

DEVELOPMENT OF WEAK MIXTURE RATING TEST METHODS

CFR Motor Method

The Motor Method which was first introduced 20 years ago is now known as the CRC-F.2 method and is still, in the U.K., the main test used in evaluating the weak mixture rating of fuels up to and including 100 octane number.

For the rating of fuels of still higher anti-knock value the method has disadvantages connected with operation as the very high compression ratios necessary to rate such fuels tend to render operation unstable and under such high pressures the operation of the bouncing pin apparatus which is used to measure knock, tends to become erratic.

This led in 1941 to the introduction in the U.K. of a modification using fixed ignition at 17° B.T.C. which required considerably lower compression ratios for testing these high anti-knock quality fuels. The method was known as the "17° Motor Method" and fuels

were rated by this method in terms of (*iso*-octane/*n*-heptane) plus 4.0 ml T.E.L/I.G. calibrated in terms of *iso*-octane/*n*-heptane up to 100 octane number and thence by extrapolation up to 120 octane number.

The discontinuity of the knock rating scale at 100 was thus overcome and the ratings of fuels above 100 octane could be expressed numerically.

Later in 1943 a further modification was made by which the engine was operated with a fixed ignition of 25° B.T.C. which was found to be the setting for maximum knock and since that time this method known as the "25° Motor Method" has been used in the U.K. for the determination of the weak mixture ratings of fuels over 100 octane number.

U.S. Army Method and CFR-IC Method

In America the use of the original Motor Method for the determination of the weak mixture ratings of aviation gasolines was virtually discontinued before the war and for some time the U.S. Army Method was used. The engine used was basically the CFR but a small bore cylinder of $2\frac{5}{8}$-inch diameter was used in place of the normal $3\frac{1}{4}$-inch bore. The bouncing pin was replaced by a thermal plug and the method was based on the temperature rise associated with detonation rather than on the pressure rise. The conditions of operation are given in Table I.

In 1940 the Army Method was replaced by the CFR-IC method which is a similar method using the standard $3\frac{1}{4}$-inch bore cylinder. This latter method which is now known as the CRC-F.3 method is in current use in the U.S.A. for weak mixture rating of aviation fuels. The conditions of operation are also shown in Table I.

Alternative Test Methods for Weak Mixture Ratings

During the war the oil industry felt that existing methods of determining weak mixture ratings were excessively severe on certain types of fuel, particularly those containing aromatics, but the aircraft engine manufacturers considered that the methods in use gave a reliable indication of weak mixture performance under the severest conditions then encountered or under conditions of increased severity which might become normal on future engine types.

As data on the relative weak mixture ratings in the full scale engine in flight were entirely lacking, there was no direct basis on which a new test method could be correlated.

A project was put in hand in the U.K. to carry out extensive weak mixture rating tests on a variety of fuels in a Halifax aircraft fitted with Bristol Hercules engines. This was a fairly long-term project and it was decided to develop a weak mixture test on the Hercules full scale single cylinder unit to provide basic data for a laboratory test. The engines were run under conditions equivalent to the most severe encountered in the full scale engine at Maximum Economy Cruise mixture strength at fuel/air ratios from 0.055 to 0.8-1, ratings being expressed in terms of the ratio of the respective minimum boost pressures (see Fig. 1). Satisfactory reproducibility and agreement between the four units used could not be obtained due mainly it was thought to unavoidable differences in the installations. Attempts to correct these differences resulted in reproducibility considerably inferior to that obtained by the 25° Motor and CRC-F.3 methods.

Several other methods were tried out using the supercharged and the naturally aspirated CFR engine.

The completion of the Hercules/Halifax flight tests previously mentioned led to the abandonment of development work on new weak mixture test methods, as the test showed that both the 25° Motor Method and the CRC-F.3 methods gave good correlation with the main engine in flight.

It had been originally intended that the CRC-F.4 method should serve both as a weak and rich mixture test as has been previously mentioned, but further attempts in the U.S. to overcome the difficulties of operation at weak mixtures were not successful. It was decided in America to retain the CRC-F.3 test for weak mixture ratings for the remainder of the war although it was realized that the method was not entirely satisfactory for rating fuels above 140 performance number due to its inability satisfactorily to distinguish between fuels in the 155 performance number range.

Since the war there has been a renewed demand for an improved weak mixture test for fuels between 100-160 performance number. A test designated as the F.21 method has been developed using a modified supercharged CFR engine and this method is now being extensively tried out in the U.S.A.

Reference Fuel Scales

At the time when the octane/heptane knock rating scale was introduced in 1927 fuels of better anti-knock quality than 100 octane were not envisaged.

The introduction of such fuels during the war made it necessary to select reference fuels of higher knock rating, but up to the present time a completely satisfactory knock rating scale covering all the grades of fuel in use has not been decided on.

The main disadvantages of the present scales may be enumerated as follows:—

(a) The number of different reference fuels in use lead to complexity in the expression of knock rating.

(b) The changeover from one set of reference fuels to another at the 100 octane level does not permit a continuous scale.

(c) Neither the octane nor the lead in octane scale provide any indication of the probable performance in an aero engine although the Performance Number scale overcomes this difficulty to a great extent.

(d) The lead in octane scale is limited to about 160 performance number because the incremental effect of T.E.L. on performance number decreases as the T.E.L. content increases. The difference in performance number between *iso*-octane and *iso*-octane plus 1.0 ml T.E.L/U.S.G. is 26 whereas between 5.0 and 6.0 ml T.E.L/U.S.G. in *iso*-octane the performance number increases by 4 numbers only.

(e) Service fuels containing constant amounts of T.E.L. are rated against either fuels containing no lead or fuels containing variable amounts of lead. This is undesirable as T.E.L. affects the sensitivity of fuels to changes in operating conditions.

Several attempts have been made to provide a satisfactory continuous reference fuel scale and both in the U.K. and in America much work was done some time ago to develop a scale provided by the use of octane/heptane blends containing a constant 10 per cent of toluene and 4.6 ml T.E.L/U.S.G. The U.K. agreed to adopt this scale but international agreement could not be obtained as the U.S. desired to complete their evaluation of the F.21 method mentioned earlier before recommending any further change in reference fuel scales. The use of leaded triptane/heptane, on which also considerable work has been done in the U.S., may also furnish a satisfactory solution to the problem.

Conclusions

The progress made in the last decade in the development of new and improved engine test methods for aviation gasolines have been largely due to the co-operation which has existed between this country and the U.S.A.

Differences in test methods have been due mainly to the non-availability of

certain types of equipment in the U.K. but have not resulted in preventing interchange of supplies.

Due to the advent of the gas turbine it seems unlikely that future developments in piston engine fuel rating technique will be on a scale commensurate with the progress recently achieved.

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BARTON LUBRICANTS PLANT OPENED

At the opening of the new grease plant at Barton, Manchester, C. M. Vignoles, O.B.E., managing director of Shell-Mex and B.P. Ltd., said that Shell's refineries in the U.K. are turning out oil products at the rate of 8½ million tons a year.

The Barton plant lies on the Manchester Ship Canal, on which there is a jetty for tankers. Eight-inch overhead pipelines convey oil from ocean-going tankers or smaller craft to the 21 million gallon tank farm across the road from the main plant, whence the oil is pumped to the factory area.

The factory is currently capable of producing between 15,000 and 20,000 tons of grease annually and increased output is shortly envisaged.

New Grease Film

This recent expansion adds to the topicality of a 27-minute sound film, titled "Grease," just released by Shell-Mex and B.P. Ltd., which makes clear some of the mysteries of the manufacture of lubricants. It opens with some interesting and informative shots showing the manufacture of ball and roller bearings. Particularly impressive is the shot which by high-speed cinematography at 2,500 exposures per second shows, for the first time on a screen, what happens when steel balls are tested to destruction at a pressure of over one million pounds per square inch.

The manufacture of grease in the laboratory and in the full scale plant is amply illustrated and examples of special grades and their uses are shown. The film is available in 16 and 35 mm and may be borrowed from divisional offices of Shell-Mex and B.P. Ltd., or from Trade Relations Department at Shell-Mex House, Strand, London, W.C.2.

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BRITISH STANDARDS

The 1951 Yearbook of the British Standards Institution records that the Petroleum Equipment Industry Standards Committee has the following work in hand:—

- Asbestos jointing and packing materials
- Bolting for the petroleum industry
- Cooking appliances using liquid gas
- Domestic appliances using kerosine
- Gas masks, respirators and canisters for the petroleum industry
- Non-sparking tools for the petroleum industry
- Pressure piping code for the petroleum industry
- Rubber hose and hose connexions
- Storage tanks for the petroleum industry
- Test kerosine
- Tubes, cold-drawn seamless alloy steel furnace
- Tubes, cold drawn seamless low-carbon steel furnace
- Tubular heat exchangers
- Valves :—
  - Cast iron wedge gate valves
  - Flanged steel check valves
  - Flanged steel globe valves

The Petroleum Industry Standards Committee is revising B.S. 210 (Classification of lubricating oils) and is considering the question of refrigerator oils. It is noted also that the Bituminous Products Committee has work in hand on several bituminous products, as has the Road Engineering Committee. Other work in hand of interest is oil burning equipment (Chemical Engineering Committee), bituminous filling compounds (Electrical Committee), discharging, loading, and packaging of carbon black (Packaging Standards Committee), refractory products for the petroleum industry (Refractory Products Committee).

AROUND THE BRANCHES

London Branch

The first meeting of the 1951/52 session of London Branch was held on the evening of September 25, 1951, at Manson House with the Chairman, N. E. F. Hitchcock, presiding. W. H. Davies, chairman of the Programme Sub-Committee responsible for the organization of the programme for this session, gave a brief outline of the talks planned and mentioned also the buffet dance on November 16. Following this, A. Beeby Thompson, O.B.E., M.I.Mech.E., M.Inst.M.M., F.G.S., gave the Branch an agreeable informal talk on "Reminiscences—A Lifetime in Oil."

Mr Beeby Thompson began by telling of his entry into the embryonic oil industry at the end of the nineteenth century and of his early experiences in what was then the only field of activity of the British oil industry, the prolific oil field of the Caucasus—remarkable days when everything was improvised, when riveted cast iron casing was used which necessitated a diameter of 30 to 40 inches at the surface to drill a 1000-foot hole, and then, with a derrick and appurtenances made entirely of wood, one drilled until the oil gushed forth, often drenching an entire neighbourhood. The lecturer pointed out that the Baku fields were, in fact, the nursery of many of the greatest figures in the British oil industry, who learned their trade in conditions where every man had to be able to turn his hand to any one of the many activities which today are each the province of the specialist.

Mr Beeby Thompson went on to describe the origins, in the early years of the twentieth century, of the world-wide British oil industry which was subsequently able to survive the loss of its original fields in the Caucasus; the outstanding events were the foundation of the Royal Dutch/Shell Group in 1907 and the start of operations in Persia in the following year. With a variety of amusing and often astonishing anecdotes and sketches of personalities the speaker went on to tell how he prospected for and discovered the first great oilfield in Peru, after which he took part in the foundation of yet another great British interest, the Burma oilfields.

From Burma, the speaker shifted the scene to Trinidad, where again he took part in some of the earliest prospecting. He described in some detail the problems of starting up operations in the island and the considerations which led him to choose Point Fortin as the original coastal base; it was fascinating for those of today's younger generation, knowing the great development of operations in Trinidad, to be able to look back through the eyes of one of the founders to the origins of the enterprise and to see what an influence the decisions of one man can have on subsequent developments over the years. After impressive tales of negro workers literally bled white during the night by vampire bats, Mr Beeby Thompson took his audience to the Californian oilfields in the first decade of this century.

At this point, unfortunately, when everyone present would willingly have sat for the rest of the evening listening to Mr Beeby Thompson's absorbing story, he was beaten by the clock. It had been a memorable experience for the younger members of the audience, familiar primarily with the immense and highly specialized organization of the oil industry today, to look back with one of the pioneers to the days of improvization and courageous effort when the boldness and independence of thought of Mr Beeby Thompson and many others like him—some of whom one was delighted to see in the audience—started the whole enterprise.

R. P. Stapleton briefly proposed a vote of thanks which was applauded

enthusiastically, whereupon the meeting closed and was followed by the customary informal dinner at the Bolivar restaurant, when Mr and Mrs Beeby Thompson were guests of the Branch and an unusually large number of members joined in—a good augury for the remainder of the session.

Scottish Branch

The first meeting for the Session 1951-52 was held in the Engineering Centre, Glasgow, on October 4, when a series of films under the heading "Refinery Processes—Gasoline (Petrol)" was exhibited.

The films were four in number and illustrated how, as the internal combustion engine changed in design to higher compression ratios and greater efficiencies, there was a demand for fuels of higher octane number. This demand was met by using petrols derived from cracking heavy oils to augment those petrols derived from straight distillation. The still higher octane values required for aviation purposes, derived from the processes of polymerization, hydrogenation, butane isomerization and alkylation, were very capably illustrated. And finally, to obtain the highest octane numbers the process of blending with tetraethyl lead was illustrated.

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A.I.O.C. PROSPECTING IN FOUR CONTINENTS

Anglo-Iranian is now prospecting on four continents on its own or in conjunction with other companies.

In Iraq, it operates in close association with the I.P.C. Group, while in Kuwait it shares the Kuwait Oil Co. with an American concern. Exploration work is going on in India and Pakistan, while farther east in Papua, New Guinea, extensive geological and geophysical surveys are being made and drilling is taking place. More than £2,000,000 has been spent by the company in Papua, so far unsuccessfully.

Parts of Africa are being surveyed, and a deep well is about to start drilling in Nigeria. Reconnaissances are in progress in Kenya and Tanganyika. There is activity in Egypt, where there are oilfields on both sides of the Gulf of Suez.

Work is in hand in Trinidad, where the possibilities of finding oil reserves under the shallow waters of the Gulf of Paria are being explored.

In the U.K., drilling is in progress on the dunes at Formby, on the Lancashire coast. Test wells are planned to a depth of about 3,500 feet. Production in the Nottinghamshire field, raised to 120,000 tons/year during the war, now only yields about 45,000 tons/year. The company has recently acquired prospecting rights in Sicily and is now conducting exploratory surveys.

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COMPANY PRODUCTION—CRUDE OIL 1951

	Tons July
Anglo-Iranian Oil Co Ltd	
Persia	470,000
Kuwait Oil Co Ltd	
Kuwait	2,720,501

	Brl. Aug.	Sept
Kern Oil Co Ltd		
California	115,414	109,121
Trinidad	59,363	59,698
Trinidad Petroleum Development Co Ltd	251,937	243,084
British Controlled Oilfields Ltd		
Venezuela Western Area ...	12,808	13,042
Central Area	15,998	15,253

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"IRAQ PETROLEUM"

The first issue of "Iraq Petroleum," the magazine of the IPC and its associated companies, appeared in August and this monthly publication is a worthy newcomer to the ranks of house magazines. Contents of the first issue vary from Part I of "The early history of our company" to a page for the children, and include a fashion page for the ladies, book reviews, news and personal items.

FAWLEY REFINERY OPENED

At the formal opening of Fawley speeches were made by Mr L. Sinclair (left), *Mr F. W. Abrams* (centre), *and Mr C. R. Attlee* (right)

Built at a total cost of £37,500,000, and the largest single petroleum refinery in Europe, the Fawley, Hampshire, refinery of the Esso Petroleum Co. Ltd., was officially opened by the Prime Minister of Great Britain on September 14, 1951.

At the opening ceremony were over 5,000 guests, including representatives of foreign embassies, of Government departments, of official bodies and scientific institutions, and of the contractors and others who had worked on the construction of the refinery, and many employees of the company.

Esso Chairman's Address

Mr L. Sinclair, M.Inst.Pet., chairman of Esso Petroleum Co., Ltd., opened the proceedings by expressing a welcome to the Prime Minister and Mrs Attlee, and to all who were present on that memorable occasion in the history of the company.

When the people of Great Britain and America were presented with big problems they invariably produced big solutions, said Mr Sinclair. At the end of the late war the British oil industry was presented with the major problem of meeting the nation's needs of over 20 million tons a year of petroleum products and, at the same time, reducing the strain on dollar resources.

How they were helping to solve that problem was evidenced by the refinery around them, from which would flow nearly a third of the national needs for petroleum. The result would be a saving of nearly $100 million a year.

The credit for the achievement belonged to many people and primarily to some 5000 British people whose loyalty, energy, and enthusiasm had enabled the plant to be brought into production nearly four months ahead of schedule. The company, the country, and all free nations of the world owed these men a debt of gratitude, said Mr Sinclair.

The company appreciated also the co-operation of the Government Ministries, the trade unions, the local authorities, and the British suppliers of equipment. Two-thirds of the equipment used in the refinery was "Made in Britain".

Their shareholders, the Standard Oil Company (New Jersey), had placed freely at their disposal the knowledge of their best technicians and a very substantial amount of new capital. As a consequence they had not had to call upon E.C.A. or any other source.

Paying a tribute to his predecessor, the late Mr R. A. Carder, Mr Sinclair said that "his interest and enthusiasm for the project and his encouragement for

The three speakers off to view the refinery with Mr R. J. Cole (Foster Wheeler Ltd.)

all who worked on it, played a very important part in its progress".

Before asking the Prime Minister to unveil the commemorative plaque, which would later be placed in the entrance hall to the administrative offices, Mr Sinclair said he wished to introduce Mr Frank Abrams, chairman of Standard Oil Co. (New Jersey), whose interest in the refinery was such that he had travelled over 3000 miles to be present.

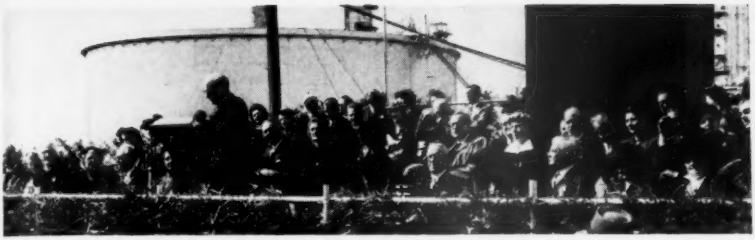
Anglo-American Co-operation

Mr F. W. Abrams, chairman of Standard Oil Company (New Jersey), said: "A fine example of progress is here before us. All around this platform we can see the impressive results of people working together to get a big job done. These steel columns and pipework, much of it already turning raw petroleum into useful products, rose here by joint effort. Some of this equipment was designed and built by my country. Even more was constructed here in the United Kingdom. The job of getting all the parts together, left largely to the skill of British craftsmanship, has now been finished—months ahead of schedule.

"To many people, investment calls up a picture of money alone. But, as the example of Fawley shows, it is clear that investment goes beyond dollars or pounds. Experience, foresight, craftsmanship, courage and—especially, faith—are also needed. It was faith in the future of Britain and in the integrity of her people that brought about this investment at Fawley. For such was the conclusion of our discussions after visiting this site three years ago.

"At home I spend some of my time growing strawberries. The habits of the strawberry plant often remind me of investment. The plant sends out parts of itself as runners, hopeful of finding a partnership with good soil where roots can be put down. Companies do much the same thing when they invest abroad.

A vast crowd gathered to witness the formal opening ceremony



The scene on the platform during the opening ceremony

"But there is an important difference between a good investment and the strawberry plant's association with the soil. The plant takes from the soil but gives nothing back to it. A good investment does more than that. Not only is it productive, but it enriches the soil itself—it contributes to the economic strength of the nation where the investment is made. And good investments benefit not only the direct participants but also the many others who are served.

"There are people who have the notion that if one party gains in commercial transactions, the other party has surely sustained loss. We have quite the opposite idea. Real international co-operation in our judgment can exist only when both parties give and both gain. In doing this they enlarge the well-being of each. That is what we expect this refinery at Fawley to do. We are hopeful it will produce for the British people and for Americans far more than each of us has put into it.

"Materials, skills and human values have gone into Fawley to make this refinery a living creative part of your country's economy. British life will tend to be strengthened and spent in easier circumstances because of it. Wouldn't more examples like this one be to the whole world's advantage? With an increasing flow of investment from one country to another, men and women everywhere would find their lives more satisfying. I am sure that is a condition we all earnesly desire.

"Perhaps it would be appropriate at this time to consider briefly how we may more effectively bring this about.

"The oil-industry, in which our two countries have been leaders for many years, is especially concerned with international investment. For oil is often found at considerable distances from where it is used. This fact calls for exploration and investment in far-away places.

"Working around the world with many partners—including national governments—we are brought face-to-face with the attitudes and aspirations of many different peoples. We learn what they rightly expect from foreign investments in their countries. The conditions necessary for our own good health becomes apparent, too. In other words, we learn from each other some of the requirements for mutual benefit.

"We know, for example, that when different people co-operate to develop an enterprise, it should be run so as to help build up the domestic economy of the country where it is located. Nationals of the country concerned should have the opportunity to be trained and employed at fair rates of pay in progressively more responsible assignments. The products turned out by the business should be sold at reasonable prices. They should be available for use in the country where they are produced as well as for export. Where natural resources are involved, these should be developed efficiently and without waste.

"People in a land which provides the opportunity for investment have rights

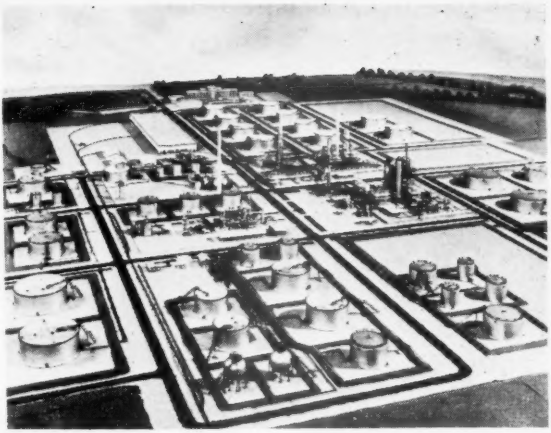
Outside and inside a portion of the tent in which luncheon was served to over 6000 guests

which merit respect. Similarly, rights which are important to those making the investment and taking the risks also deserve consideration. My own company's viewpoint is that in all countries in which we operate we should be able to rely on mutual respect for the title to property we have acquired or which has been produced by our talents and labour. Furthermore, to employ effectively our skill and facilities, we need managerial control of our business.

"Both the country whose resources are developed or employed and the investor who gives them economic value should fairly share any revenues resulting from development within the country. Of course, there is no easy formula for determining this division. With respect to development of a nation's resources of oil in the ground, however, a practical goal—amounting to an equal division of benefits between the nation and the investors—seems to be evolving. We think such a goal in these cases is a reasonable one.

"Perhaps most important of all is the confidence of each party in the other. Usually the terms of an agreement are set forth in writing. The resulting contract contains conditions on which both parties can count when they assign property and rights, and make long-term investments of capital and skill. Confidence in the continued honouring of such a contract is essential in any international investment.

"Of course, changes in the terms of a contract may be agreed upon from time to time. No one—however wise—can anticipate equities or developments stretching whole decades into the future. But such changes surely must be discussed and agreed upon. The parties must be ready to carry on their discussion in the same spirit, with the same objective and the same sincerity as guided them when the agreement was first reached. This requires mutual faith and respect. If we adhere sincerely to the over-riding principle that both parties must be fairly served, I believe it can be realized. The most articulate apostle pointed the way for us when he wrote to the Corinthians: 'The letter killeth, but the spirit giveth life'.



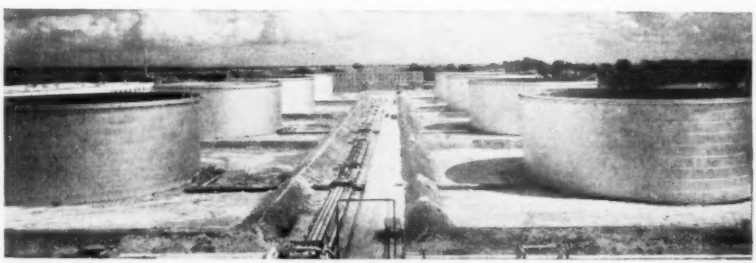
This scale (1/32 inch to a foot) model built by three Esso employees, shows the spacious layout of the refinery

"Without these minimum assurances which I have outlined, the life-giving streams of foreign investments by private companies will dwindle and ultimately disappear.

"You will notice my reference to 'private' companies. Our opinion grows stronger every day that the presence of a private investor in an international partnership is an encouraging forecast of its success. For the dealings of private investors with governments tend to concentrate in the specialized area of business affairs; they are not complicated by the many other issues to which governments have to pay attention. It follows that difficulties are often more easily settled in international partnerships where private investors are involved.

"The plural of the word 'company' is used deliberately. Our experience has been that progress is best made in an atmosphere of competition. Several companies—distributing risks and all contributing, each in its own way, to the accumulation of knowledge and experience—produce the best results. When competition is keen, the exercise of keeping up with it sharpens wits and strengthens muscles. In the struggle to achieve, companies become stronger and more efficient. Consumers profit thereby. For the essence of competition is the creation of new opportunities.

"We believe the elements of sound,



Each of these Whessoe tanks (140 ft dia by 54 ft high) has a capacity of over five million gallons of crude oil. Horton pontoon floating roofs are fitted

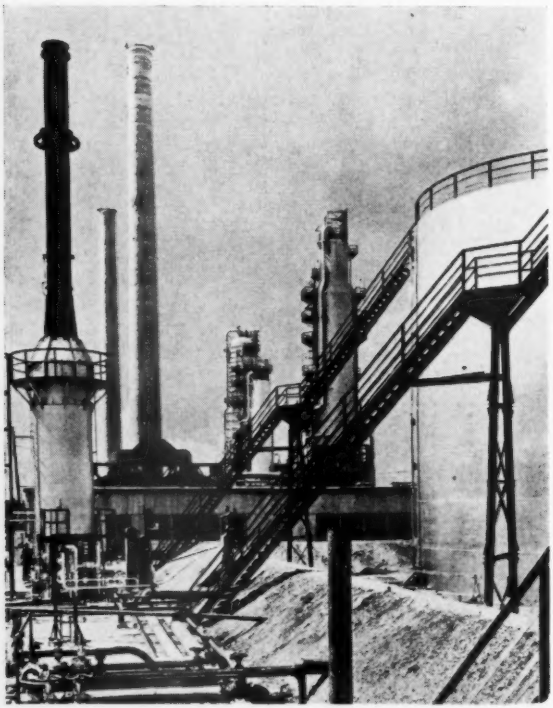
creative international investment are present in this great refinery. In these changing times Fawley does much to strengthen my spirit. This refinery is a concrete example of the kind of constructive effort which shows we have faith in the future and in each other. You may be sure that Esso Petroleum Company and Standard Oil Company (New Jersey) will make every effort to see that this refinery fulfils the hopes that you and we both have for it.

"It was put here to produce more and better products for people. Come what may, we will do our level best to keep it doing just that."

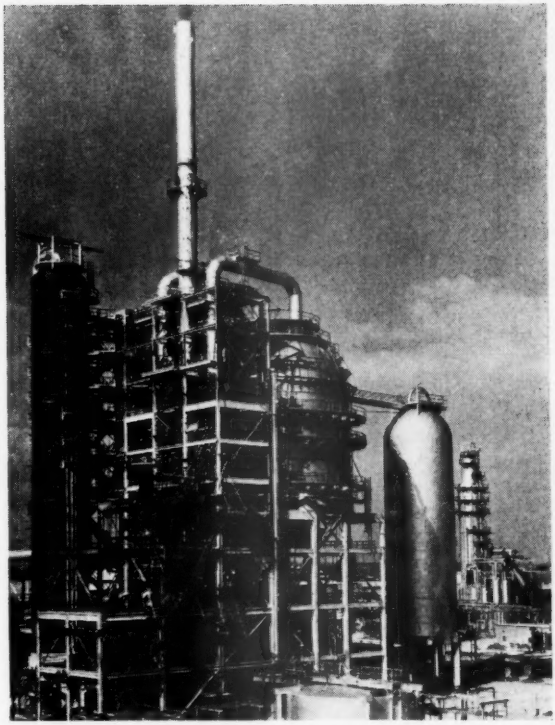
The Opening Ceremony

Mr **C. R. Attlee**, Prime Minister of Great Britain, said it was a great pleasure for him to have the privilege of declaring open the largest refinery in Europe. It was especially pleasing to see there representatives from across the Atlantic and other countries together with so many of his own fellow countrymen. It must be a proud day for Mr Sinclair to see the great venture brought to fruition, and they were glad to see there Mr Abrams, chairman of the parent company, with a number of his colleagues. It is a happy thing, too, that there were present representatives of the contractors who built Fawley refinery, and the workers, to whose skill and energy it is a monument, and also of those who have been engaged in its activities.

Referring to the reasons why His Majesty's Government welcomed the



On the left is the fuel oil heater for the boiler plant, the single-stage and two-stage crude distillation units being in the background

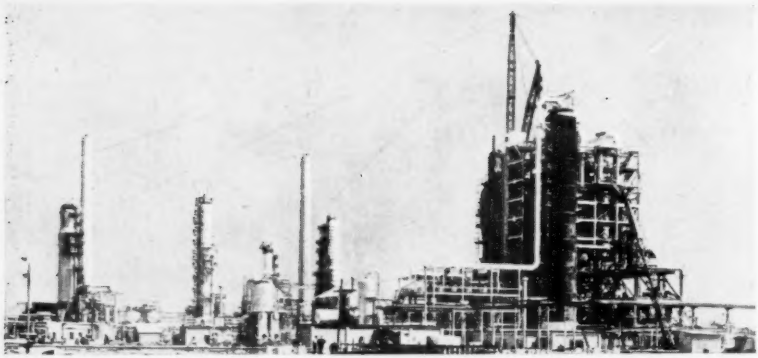


The cat cracker has a throughput of over 1,430,000 gallons per day

Fawley project and had done what it could to help the company to bring it to completion, Mr Attlee said: "Before the war, oil refineries were built as near as possible to sources of the crude oil, and refined products were shipped to their markets, but in recent years that policy has changed. Companies are building their big refineries near their markets, and while there are some disadvantages, the advantages outweigh them. For instance, different sources of crude oil can be used and petroleum chemical industries can be developed using the gases and by-products produced in the refining process.

"The Government have been glad to encourage this policy. Before the war only 2½ million tons of petroleum products were produced here but soon, thanks largely to Fawley, United Kingdom refineries will produce 20 million tons. One of the benefits of Fawley refinery will be that it has a plant for making use of sulphur, which I understand is a nuisance in petroleum but a necessity for many industrial processes. The supply of sulphur has been causing us some anxiety. The 12,000 tons it is hoped to produce at Fawley will make a very useful contribution to our supplies.

"But of greater importance is the contribution which Fawley will make to the solution of our balance of payments problem. When the cost of refining arises in this country it is obvious that it means a considerable



A general view of the main refinery units at Fawley

saving in foreign currency, especially dollars. This project has in fact played a major part in last year's negotiations on the dollar-sterling oil question, which led to agreement between the Government and the New Jersey and other companies.

"It is a good thing, both for United States and ourselves, that we should compete in the Sterling Area, but the very heavy dollar bills which we had to incur for oil made it necessary for us to seek all practicable means of reducing this burden. Well, frankly, there were differences of view between us and the American companies, but these happily have been smoothed out. As far as the New Jersey Company were concerned, one of the main reasons for making it possible to reach an amicable agreement was in fact that Fawley refinery would make a substantial reduction in dollar cost of their oil. The company played a very great part in negotiations which enabled us to do away with petrol rationing.

"The Fawley enterprise is a great example of British and American co-operation and this applies not merely in the field of policy but in that of execution. All who have been concerned, technicians, draughtsmen, foremen, metalworkers, craftsmen, labourers, can take pride in their achievement. Other big plants have been built up over the years, stage by stage, but Fawley is the biggest single constructional refinery job ever undertaken; and begun only in 1949, this main stage has been completed nearly half a year ahead of schedule.

"Mr Abrams has made some very profound remarks on importance of international investment and the way it can be made to the mutual benefit of the countries concerned. We have had a great deal of experience of overseas investments ourselves, and I strongly endorse his view that mutual confidence and fair terms are the basis for any satisfactory relationship.

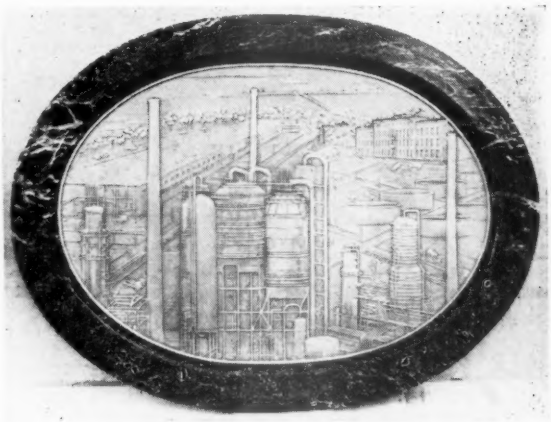
"During the 19th century Great Britain, as then the leading industrial country, did an immense amount to open up to the world new sources of supply. Indeed, there was as he says, much British investment on the American continent. Responsibility for much of this work in future will fall on the United States, and it is clear that if the great task of raising the standard of life in undeveloped parts of the world is to be successful, there must be a great development of resources; but Fawley has shown how two great industrial countries can co-operate in this field. The bulk of the capital has been provided out of the accumulated resources

of the Esso Company, and this in effect, represents a dollar investment. In former days the usual picture in the oil industry was a friendly rivalry between British and American companies overseas, but in times of difficulty there was always co-operation. This was notably so in the second world war. Indeed, world conditions to-day, far more frequently than in the past demand co-operation.

"Oil is highly inflammable, and there have been occasions when oil questions have generated great heat. The problem of Persian oil might be described as a 'burning question'. Clearly, it is not appropriate for me to discuss the issues involved to-day, but the fact that oil supplies from Persia have been interrupted raises a problem. Alternative supplies have to be sought, and such supplies should, as far as possible, not increase the dollar cost. The British companies have set up an Oil Supplies Advisory Committee to advise the Government, and there is a similar committee of American companies called Foreign Petroleum Supplies Committee; these two committees have established very close relations and their co-operation has been most fruitful. So far as they have been dealing with the situation during the remainder of 1951 you will be glad to know that supplies of motor spirit sufficient to replace those normally exported from Abadan have been guaranteed up to the end of 1951; and while there will be a deficiency in some products it will not be large. There is every reason to think that position in 1952 will show an improvement. There will be more time to develop alternative supplies. I hope that this fact will be duly noted by all those Persians (and I am sure they are the majority) who do not wish to see their country ruined. We are anxious to come to an agreement with Persia, to resume our friendly co-operation, but Persians must realize that a long delay may lose markets for Persian oil.

"In conclusion, may I emphasize again what a pleasure it is for me to take part in this ceremony. I have now been almost continuously in office for over 11 years, and during that time I have seen an ever-closer co-operation between Britain and United States. Fawley is a tangible proof of the constructive work we can do in partnership.

"I have very great pleasure in declaring the refinery open, and in unveiling the Memorial Plaque."



The silver plaque, inlaid in Tinos marble, which was unveiled at the opening ceremony, was the work of Mr G. T. Friend

THE REFINERY AND ITS CONSTRUCTION

The first impression of the visitor to Fawley is one of spaciousness, almost of wide open spaces. With an area of 450 acres at their disposal, the designers had the distinct advantage of being able to plan the locations of the various units in such a way that each piece of plant is isolated from its companions in the vast enterprise. Connecting pipes are all neatly laid in parallel rows, tanks are equally spaced, and there is an air of orderliness.

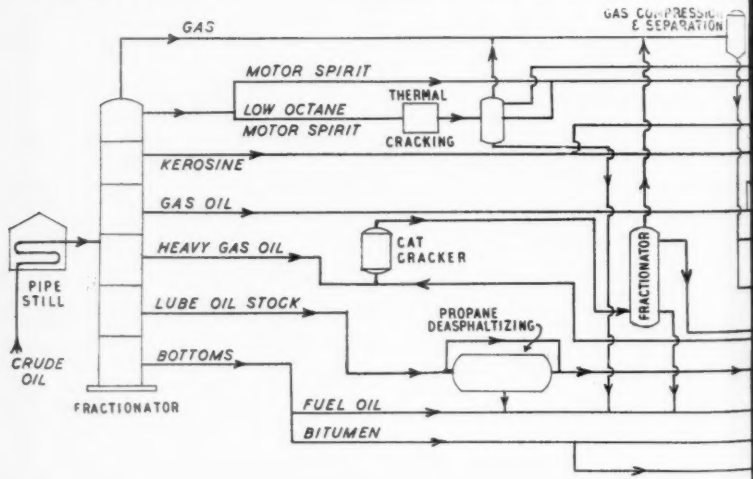
Work on the construction of the Fawley refinery commenced in July 1949 when the clearance of the site was started. Since then the construction staff, which at the peak period totalled over five thousand men, have worked continuously to complete the present portion four months ahead of the scheduled date.

In the construction of the refinery some 100,000 tons of steel have been used, together with 300 miles of pipe of steel, cast-iron, or concrete, 200 miles of electric wiring, 100,000 cubic yards of concrete, 12,000 valves, 220 pumps, and 1,600 lb of mercury.

At the time of its opening the throughput of the refinery was about 102,000 barrels per day but, when all units are completed and in full operation in 1953, capacity will be 130,000 barrels per day of crude oil.

The refinery is intended to operate mainly on Middle East crude oils and when completed will produce some 6 million tons per year of petroleum products, or nearly 30 per cent of the present total demand of the U.K. Approximate total output is estimated as:

	Thousand tons per year
Liquefied petroleum gases	20
Motor spirit	1,770
Solvent naphtha and white spirit	60
Kerosine	240
Turbo jet fuel	100
Diesel fuel:	
High speed	300
Light industrial	150
Marine	40
Tractor fuel	370
Gas oil for gas works	310
Light fuel blending stock	40
Lubricating oils	200
Residual fuel oil	2,260
Bitumen	110



Crude storage capacity consists of ten 150,000-barrel floating roof tanks, the total capacity being sufficient to keep the refinery going for about 14 days.

The Plant

Fawley refinery is equipped with two distillation units, an atmospheric unit with a capacity of 65,000 barrels per stream day and a combined atmospheric-vacuum unit of similar capacity.

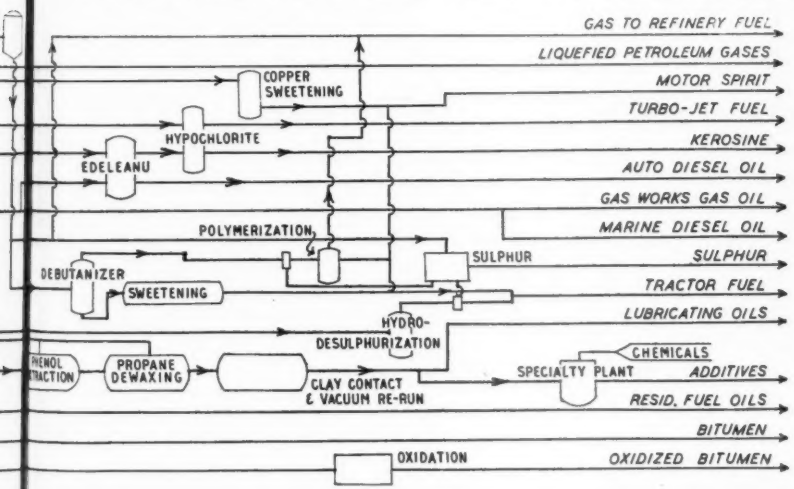
The pipe still furnace for the atmospheric unit has two convection and two heating banks and the column, which is 124 feet in height and 21 feet in diameter, is provided with 35 bubble trays. This column is designed to distil down to about 25 per cent bottoms according to the type of crude used as feed stock.

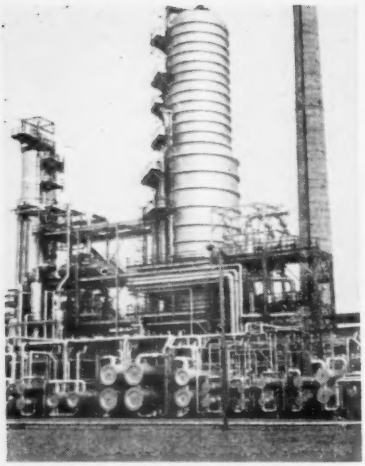
For the atmospheric-vacuum unit a double furnace pipe still unit is provided, the first feeding the atmospheric column. The second furnace has a convection and a radiant heat bank and feeds the vacuum column. The atmospheric column is 90 feet high, 15 feet 6 inches in diameter for the lower half and 13 feet in diameter in the upper portion. It has a total of 26 trays. The height of the vacuum column is 130 feet and the diameter of the middle section is 28 feet. Middle East crude can be taken down to 25 per cent residuum in this unit.

The cat cracker, which has a throughput of 41,000 barrels per day, operates on the fluid catalyst principle devised by the Standard Oil Development Co. For the production of high octane gasoline and a high gas yield one type of catalyst is used, while a different type is available when it is desired to produce a fuel of lower octane value and to get a lower gas output. The catalyst can be changed at will. Feed stock for the cat cracker will mainly be the heavy waxy gas oil from the distillation units with some extract and wax from the lubricating oil plant.

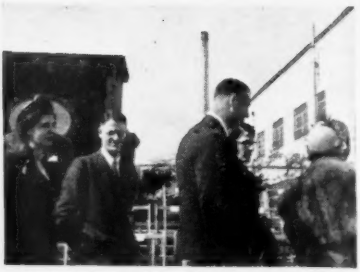
Product from the cat cracker will pass to a 130 by 20 foot fractionation column with 20 trays, which will give a wet gas, gasoline and side streams of heavier fractions. From the column the gas and gasoline are led to the debutanizer, this column being 88 feet in height, 10 feet in width and provided with 31 trays.

In addition to the main units referred to above, there are the usual treating plants.





The two-stage distillation unit, the vacuum tower being in the centre and heat exchangers in the foreground



Among those on the platform at the opening ceremony were Hugh C. Tett, vice-president of the Institute, and Mrs Tett (left)

Thus, the Edeleanu plant for treating kerosine with sulphur dioxide has a throughput of 13,000 barrels per day, and the various other units are shown in the flow diagram accompanying this account.

For the storage of intermediate and finished products tankage for four million barrels is provided, this including two Horton spheres for the liquefied petroleum gases.

In a refinery of this size the question of maintenance is an important one. Fawley includes what is probably the largest maintenance building in Europe. This building, 800 feet long and 180 feet wide, contains up-to-date machine tools, is provided with ample lifting gear, and is connected to the railway.

The Marine Terminal

To feed such a refinery and to take away the refined products necessitates provision of adequate berthing facilities for tankers. Consequently it was necessary to construct an entirely new jetty, some 3200 feet in length, into Southampton Water, and here it is possible to berth at one time four of the largest tankers yet constructed. In fact, the berths are capable of taking 39,000-ton tankers when these are built.

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CONGRESS ON ANALYTICAL CHEMISTRY

Further details have been announced concerning the International Congress on Applied Chemistry to be held in Britain from September 4-9, 1952.

Programme for the scientific sessions, which will be held in the rooms of the "Examination Schools," Oxford, is in the hands of a committee under the chairmanship of the Government Chemist, Dr G. M. Bennett, C.B.E., F.R.S.

During the period of the Congress it is proposed to have in operation working demonstrations illustrating new techniques or special applications of older techniques in analytical chemistry.

In addition, there will be a trade exhibition of apparatus and books, under the management of W. T. Thompson of Imperial College.

The Congress Hon Secretary is R. C. Chirnside, Research Laboratories, The General Electric Co. Ltd., Wembley.

WORLD PETROLEUM STATISTICS, 1950

According to the Bureau of Mines of the U.S. Department of the Interior,* world production of crude petroleum in 1950 was 11.5 per cent higher than in 1949. Greatest production increases were in the U.S.A., the Middle East, and Venezuela. In the four tables reproduced herewith are given details of crude oil supply and demand during 1950, production of refined products in 1950, details of bunker oil deliveries, and an estimate of domestic demand for countries where reasonably complete figures are available. In general the demand figures are derived from the formula: refinery production (including refinery consumption), plus imports, minus exports, and plus or minus stock changes where available. Bunker oils have been included in the imports and in the demand of the country where loaded.

In compiling these figures the following definitions have been used: *Motor fuel* includes aviation and other gasolines and naphthas from crude oil, natural gasoline, alcohol, or benzole blended; *Kerosine* includes all grades for power, lighting, and range use; *Distillate fuel oil* includes gas oil, light diesel oil, and light heating oils; *Residual fuel oil* includes heavier residuals used for bunkering or boiler fuels; *Lubricating oil* includes all grades and oils used in grease manufacture.

*"World petroleum statistics—1950." Prepared by F. X. Jordan. U. S. Department of the Interior, Bureau of Mines, WPS No. 25, 1951.

TABLE I
WORLD SUPPLY AND DEMAND—CRUDE PETROLEUM—1950
(thousands of barrels)

Country	*Production*	*Imports*	*Exports*	*Crude runs to stills*	*Other demand and losses*	*Stock exchange*
NORTH AMERICA						
Canada	28,715	81,791	—	108,941	300*	1,265†
Cuba	120*	1,993	—	2,007	—	106
Mexico	72,443	—	16,112	53,457	2,387	487
United States	1,971,845	177,714	34,798‡	2,094,867	24,787	—4,893
Total	2,073,123	261,498	50,910	2,259,272	27,474	—3,035
Daily average	5,680	716	139	6,190	75	—8
SOUTH AMERICA AND CARIBBEAN						
Argentina	23,353	21,750†	—	43,500†	403†	1,200†
Bolivia	616	—	54	621	3	—62
Brazil	278	395	—	600*	73	—
Chile	629	—	470	—	15	144†
Colombia	34,059	—	24,588§	8,756	700	15
Ecuador	2,632	—	1,042	1,617	10	—37
Neth. Antilles	—	283,272	6,765	275,752	—	755
Peru	15,077	—	2,930	12,128	50	—31
Trinidad	20,632	11,375	2,448	29,409	150	—
Uruguay	—	5,531	—	5,330	—	201
Venezuela	546,783	—	452,453	90,540	4,233	—443
Total	644,059	322,323	490,750	468,253	5,637	1,742
Daily average	1,765	883	1,345	1,283	15	5
WESTERN EUROPE						
Belgium	—	3,275	—	3,285	—	—10
Denmark	—	232	—	221	—	11
France	909	103,855	64	106,739	141	—2,180†
Western Germany	7,904	16,220	—	23,897	60	167
Italy and Trieste	63	37,466	—	37,076	50	403
Netherlands	4,897	34,855	—	40,670	50	—968
Norway	—	133	—	92	—	41
Portugal	—	1,963	—	2,124	—	—161
Spain	—	2,108	—	2,010	—	98
Sweden	—	6,615	—	6,500*	—	115*
United Kingdom	340	67,923	—	66,960	120	1,183†
Total	14,113	274,645	64	289,574	421	—1,301
Daily average	39	752	—	793	1	—3

TABLE I (*continued*)
WORLD SUPPLY AND DEMAND—CRUDE PETROLEUM—1950
(thousands of barrels)

Country	*Production*	*Imports*	*Exports*	*Crude runs to stills*	*Other demand and losses*	*Stock exchange*
MIDDLE EAST						
Bahrein Island	11,016	46,287	—	56,900	98	305
Egypt	16,373	—	—	16,608	75	−310†
Persia	242,475	—	49,640	191,175	1,660*	—
Iraq	49,919	—	46,099	2,835*	985	—
Israel	—	1,670	—	1,532	—	138
Kuwait	125,722	—	116,696	7,794	100	1,132
Lebanon	—	3,682	—	3,682	—	—
Qatar	12,268	—	11,700*	—	110*	458*
Saudi Arabia	199,547	—	153,036	38,364	256	7,891
Turkey	54	—	—	52	2	—
Total	657,374	51,639	377,171	318,942	3,286	9,614
Daily average	1,801	141	1,033	874	9	26
OTHER ASIA						
China	730*	—	—	700*	30*	—
India-Burma and Pakistan	3,117	—	—	2,950†	167†	—
Formosa	23	707	—	730	—	—
Japan	2,048	9,640	—	10,727	40	921
Total	5,918	10,347	—	15,107	237	921
Daily average	16	28	—	41	1	2
OTHER AFRICA						
Algeria	24	—	—	—	24	—
Canary Islands	—	5,910	—	5,777	—	133
French Morocco	305	—	—	295	10	—
Total	329	5,910	—	6,072	34	133
Daily Average	1	16	—	17	—	—
OCEANIA						
Australia	2	5,460	—	5,460†	2	—
British Borneo	30,958		11,300	69,679	347	−220†
Indonesia	50,148¶					
New Zealand	7	—	—	—	7	—
Total	81,115	5,460	11,300	75,139	356	−220
Daily average	222	15	31	206	1	−1
TOTAL ABOVE COUNTRIES	3,476,031	931,822	930,195	3,432,359	37,445	7,854
Daily average	9,524	2,553	2,548	9,404	103	22
USSR AND EASTERN EUROPE						
USSR**	273,200†		—	265,000*	8,200*	—
Other Eastern Europe	46,960*	730*	—	47,000*	690*	—
Total	320,160	730	—	312,000	8,890	—
Daily average	877	2	—	855	24	—
WORLD TOTAL	3,796,191	932,552	930,195‡	3,744,359	46,335	7,854
Daily average	10,401	2,555	2,548	10,259	127	22

*Estimated.
†Partly estimated.
‡Excludes shipments in military custody to Japan.
§Excludes 3,681,000 brl reduced crude delivered to pipeline and mixed with crude exported.
Includes crude processed for export at Naples refinery.
¶Includes New Guinea production, 1,748,473 brl. **Includes Sakhalin.

TABLE II
PRODUCTION OF MAJOR REFINED PRODUCTS BY COUNTRIES, 1950
(thousands of barrels)

Country	*Motor fuel*	*Kerosine*	*Distillate fuel oil*	*Residual fuel oil*	*Lubricating oil*	*Total major products*
NORTH AMERICA						
Canada	47,498	6,286	18,331	26,508	1,793	100,416
Cuba	707	495	414	215	2	1,833
Mexico	11,843	4,489	5,375	30,362	233	53,302
United States	1,024,448	118,512	398,912	425,217	51,735	2,018,824

TABLE II (*continued*)
PRODUCTION OF MAJOR REFINED PRODUCTS BY COUNTRIES, 1950
(thousands of barrels)

Country	*Motor fuel*	*Kerosine*	*Distillate fuel oil*	*Residual fuel oil*	*Lubricating oil*	*Total major products*
SOUTH AMERICA AND CARIBBEAN						
Argentina	13,100†	4,300†	5,200†	17,000†	700†	40,300
Bolivia	329	72	43	165	—	609
Brazil	200*	45*	90*	205*	—	540
Colombia	2,117	387	553	6,230‡	76	9,363
Ecuador	526	122	244	691	4	1,587
Neth. Antilles	49,462	14,879	34,587	171,384	1,251	271,563
Peru	4,958	1,186	1,375	5,488	78	13,085
Trinidad	6,490	1,765	4,410	16,000	1	28,666
Uruguay	1,468	824	454	2,492	—	5,238
Venezuela	14,762	2,172	16,459	51,272	155	84,820
WESTERN EUROPE						
Belgium	750	80	784	1,052	—	2,666
Denmark	—	—	71	—	—	71
France	27,432	2,342	21,894	40,200	2,035	93,903
Western Germany	8,288	658	4,070	3,136	3,845	19,997
Italy and Trieste	8,022	2,344	7,059	15,298	402	33,125
Netherlands	11,579	613	7,187	18,641	149	38,169
Norway	18	—	19	6	17	60
Portugal	588	429	395	700	—	2,112
Spain	567	141	512	763	—	1,983
Sweden	1,500*	400*	810*	3,000*	120*	5,830
United Kingdom	12,901	1,282	13,913	29,755	2,993	60,844
MIDDLE EAST						
Bahrein Island	15,432	5,648	10,021	24,958	—	56,059
Egypt	1,653	1,160	851	10,847	—	14,511
Persia	38,738	17,833	33,478	87,826	—	177,875
Iraq§	542	535	120	1,475	—	2,672
Israel	261	208	280	601	—	1,350
Kuwait	124	41	1,654	5,780	—	7,599
Lebanon	882	472	620	1,593	—	3,567
Saudi Arabia	8,350	2,947	10,542	15,738	—	37,577
Turkey	5	2	—	25	—	32
OTHER ASIA						
China	210*	70*	35*	315*	—	630
India-Burma and Pakistan	700*	500*	600*	650*	175	2,625
Formosa	180	100	75	340	—	695
Japan	2,553	479	2,095	3,691	991	9,809
OTHER AFRICA						
Canary Islands	1,287	251	1,558	2,162	—	5,258
French Morocco	21	27	97	126	—	271
OCEANIA						
Australia	2,300*	175*	750*	1,400*	225*	4,850
Indonesia and British Borneo	21,641	6,572	20,239	19,671	—	68,123
TOTAL ABOVE COUNTRIES	1,344,432	200,843	626,176	1,042,978	66,980	3,281,409
Daily average	3,683	550	1,716	2,857	184	8,990

*Estimated.
†Partly estimated.
‡Includes reduced crude, 3,681,000 brl.
§1949 figures.

TABLE III
BUNKER OIL DELIVERIES TO VESSELS ENGAGED IN INTERNATIONAL TRADE, 1950
(thousands of barrels daily)

Zone	*Gas, diesel and other oils*	*Fuel oil*	*Total*
United States (Continental)	14.3	139.2	153.5
Canada	1.1*	11.0*	12.1*
Central and South America	5.1	28.3	33.4
West Indies	19.1	58.1	77.2
West Africa	5.0	9.5	14.5
U.K. and Irish Republic	10.9†	34.1†	45.0†
N. Europe (including French and Atlantic Ports)	18.9	45.1	64.0
Mediterranean (including Spain and Portugal)	14.8	30.9	45.7
Middle East (including Egypt, Red Sea and Persian Gulf)	32.2	88.7	120.9

TABLE III (*continued*)
BUNKER OIL DELIVERIES TO VESSELS ENGAGED IN INTERNATIONAL TRADE, 1950
(thousands of barrels daily)

Zone	*Gas, Diesel and other oils*	*Fuel oil*	*Total*
South and East Africa	3.8	7.7	11.5
India, Burma and Ceylon	2.8	17.8	20.6
East and South Asia (including Indonesia and Japan)	8.2	21.4	29.6
Australasia	3.7	14.0	17.7
TOTALS	139.9‡	505.8‡	645.7‡
Total Foreign	125.6	366.6	492.2

*Estimate—Canadian figures not available.
†Breakdown between distillate and residual bunkers not available from British Ministry of Fuel and Power, therefore estimated.
‡British figures exclude supplies from company tankers.

TABLE IV
ESTIMATED DOMESTIC DEMAND FOR MAJOR PRODUCTS, 1950
(thousands of barrels)

Country	*Motor fuel*	*Kerosine*	*Distillate fuel oil*	*Residual fuel oil*	*Lubricating oil*	*Total major products*
NORTH AMERICA AND CARIBBEAN						
Alaska and Hawaii*	3,592	169	2,340	4,367	119	10,587
Canada	52,696	8,420	22,829	32,138	2,300	118,383
Central America	2,025	350	2,840	5,600	85	10,900
Cuba	3,165	512	1,015	9,102	155	13,949
Mexico	14,925	4,500	4,575	26,300	600	50,900
Puerto Rico	1,940	605	221	2,352	60	5,178
United States	994,412	117,846	394,697	552,944	38,876	2,098,775
Other W. Indies	2,650	440	7,315	29,290	120	39,815
SOUTH AMERICA						
Argentina	13,700	4,400	5,400	32,000	1,000	56,500
Bolivia	430	75	90	272	12	879
Brazil	12,635	1,875	4,110	11,873	809	31,302
Chile	2,236	340	743	4,056	116	7,491
Colombia	3,512	389	845	2,602	118	7,466
Ecuador	670	122	244	736	21	1,793
Peru	2,702	952	828	4,315	59	8,856
Uruguay	1,600	820	600	3,725	N.A.	6,745
Venezuela	5,645	1,957	4,468	8,210	260	20,540
Other	150	35	30	—	15	230
WESTERN EUROPE						
Belgium and Lux.	6,646	305	3,408	5,518	700	16,577
Denmark	3,532	430	2,437	3,326	238	9,963
Finland	2,100	476	636	404	129	3,745
France	22,328	1,332	12,022	34,585	2,418	72,685
W. Germany	9,535	600	7,680	2,825	3,885	24,525
Greece	1,937	575	1,710	3,634	112	7,968
Iceland	377	20	640	351	22	1,410
Ireland	2,177	602	600	1,235	100	4,714
Italy and Trieste	6,100	1,583	5,906	17,248	868	31,705
Netherlands	6,500	1,921	5,729	11,470	450	26,070
Norway	2,200	275	4,000	3,700	190	10,365
Portugal	1,120	835	865	1,430	110	4,360
Spain	4,030	301	2,225	3,250	355	10,161
Sweden	6,000	1,900	7,600	9,975	565	26,040
Switzerland	2,570	394	4,314	503	276	8,057
U. Kingdom	49,430	12,115	22,585	35,000	5,275	124,405
MIDDLE EAST						
Bahrein Island	52	33	704	5,393	5	6,187
Jordan	184	160	80	—	4	428
Iraq	755	900	150	2,650	60	4,515
Kuwait	126	42	111	4,909	2	5,190
Saudi Arabia	733	47	1,652	8,463	12	10,907
Syria-Lebanon	1,020	535	800	1,015	46	3,416
Turkey	1,775	1,040	775	300	150	4,040
OTHER ASIA						
Burma	688	221	207	93	50	1,259
Ceylon	883	419	1,122	3,600	43	6,067
India	5,885	7,348	4,207	6,105	1,330	24,875
Indo-China	887	251	241	161	47	1,587
Japan	3,015	480	3,450	7,550	995	15,490

TABLE IV (*continued*)
ESTIMATED DOMESTIC DEMAND FOR MAJOR PRODUCTS, 1950
(thousands of barrels)

Country	*Motor fuel*	*Kerosine*	*Distillate fuel oil*	*Residual fuel oil*	*Lubricating oil*	*Total major products*
Malaya	1,700	523	3,187	4,372	130	9,912
Pakistan	1,190	1,200	780	3,376	124	6,670
Thailand	756	424	810	—	38	2,028
AFRICA						
Algeria	1,730	425	1,090	4,400	160	7,805
Egypt	2,570	4,580	4,731†	17,145†	315†	29,341
Ethiopia	58	8	70	10	6	152
Fr. Morocco	1,545	218	649	1,245	83	3,740
Rhodesia and Nyasaland	1,006	205	192	—	N.A.	1,403
Sp. Morocco and Tangier	157	29	134	—	26	346
Tunisia	572	246	474	488	50	1,830
Un. So Africa	8,858	2,845	2,600	2,831	493	17,627
OCEANIA						
Australia	18,245	3,570	8,150	6,125	1,410	37,500
Indonesia	2,992	2,200	2,500	6,200	209	14,101
New Zealand	4,230	190	415‡	2,370§	222	7,427
Philippine Is.	4,210	1,313	2,115	1,877	197	9,712
TOTAL ABOVE COUNTRIES	1,311,089	196,923	576,943	955,014	66,625	3,106,594
Daily average	3,592	539	1,581	2,616	183	8,511

*Territory breakdown not available.
†Includes transit trade in ships bunkers.
‡Automotive diesel oil.
§Includes industrial diesel oil.

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"OIL AND PETROLEUM YEAR BOOK 1951"

Now in its forty-second year of publication, the annual issue of this directory of the petroleum industry is an event in the industry. The current edition has just made its appearance, and its 278 pages of text contain valuable details of 762 companies operating in all branches of the industry, and the names and addresses of 492 managers and engineers and the companies with which they are associated.

There is also a Buyers' Guide in which suppliers of equipment for the industry are listed under over 700 headings. Price is £1 (£1 1s post free) and copies are obtainable from Walter E. Skinner, 20 Copthall Avenue, London, E.C.2.

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The new board of directors of Anglo-Egyptian Oilfields Ltd, at their first meeting in Cairo (l. to r.) H.E. Hassan Moukhtar Rasmy Pasha, C.B.E.; the Hon. Sir Cecil Campbell, K.B.E., C.M.G.; H.E. Hussein Sirry Pasha; R. G. Searight; G. S. Taitt, F.Inst.Pet.; Abdelsalaam Bey Osman; I. D. Davidson, F.Inst.Pet.

FORTHCOMING MEETINGS

THE INSTITUTE

Methods for Expressing the Viscosity-temperature Relationships of Lubricating Oils. F. T. Blott, B.Sc. ("*Shell*" *Refining & Marketing Co.*) and C. G. Verver, B.Sc., (*Koninklijke/Shell Laboratorium, Amsterdam*). At 26 Portland Place, London, W.1, 5.30 p.m. (*tea 5 p.m.*), November 29.

Pre-flame Reactions in a Diesel Engine. Prof. F. H. Garner, O.B.E., Ph.D., Prof. F. Morton, Ph.D., and W. D. Reid (*University of Birmingham*) and W. E. Malpas and E. P. Wright (*Trinidad Leaseholds Ltd.*). At 26 Portland Place, London, W.1, 5.30 p.m. (*tea 5 p.m.*), December 12.

Some Aspects of Field Operations in Kuwait. E. Boaden, O.B.E., B.Sc., and E. C. Masterson, B.Sc. (*Kuwait Oil Co. Ltd.*). At 26 Portland Place, London, W.1, 5.30 p.m. (*tea 5 p.m.*), December 12.

Fawley Branch

Production of Piping and Tubing. P. A. Matthews. At Esso Recreation Club, Holbury, 7.30 p.m., December 12.

London Branch

Oil on the Screen. A. W. Deller, D.F.C. At 26 Portland Place, London, W.1, 6 p.m. (*tea 5.30 p.m.*), December 17.

Northern Branch

Film Show. At Engineer's Club, Albert Square, Manchester 2, 6.30 p.m., December 18.

Scottish Branch

Annual General Meeting. The Application of Gas Turbine Technique to Steam Power. At Edinburgh, January 10.

Stanlow Branch

Scientific Film Show. At Tatler Theatre, Chester, 2.30 p.m., November 25.

Scottish Shale-Oil Industry. G. H. Smith, M.C., Ph.D., A.R.T.C. Joint meeting with R.I.C. At Grosvenor Hotel, Chester, 7.30 p.m., December 19.

OTHER SOCIETIES

The Control of Boilers Fired by Solid Fuels in Suspension. Llewelyn Young. Institution of Mechanical Engineers. At Storey's Gate, London, S.W.1, 5.30 p.m., November 23.

The Design and Performance of Cyclone Separators. C. J. Stairmand. Institution of Chemical Engineers, Midlands Branch. At Latin Theatre, The University, Edmund Street, Birmingham, 3 p.m., December 1.

Development of Hot Rolled Gravel Asphalt for Trunk and other Roads in East Anglia. D. J. Swift, B.Eng., A.M.I.C.E. The Institution of Civil Engineers. At Great George Street, London, S.W.1, 5.30 p.m., December 4.

The Measurement and Interpretation of Machinery Noise with Special Reference to Oil Engines. C. H. Bradbury. Institution of Mechanical Engineers. At Storey's Gate, London, S.W.1, 5.30 p.m., December 7.

The Pattern of the Oil Industry. C. T. Brunner. Institute of Transport. At Jarvis Hall, 66 Portland Place, London, W.1, 5.45 p.m., December 10.

The Planning of Maintenance in Chemical Works. H. Birchall. Society of Chemical Industry (Chemical Engineering Group). At Burlington House, London, W.1, 5.30 p.m., December 11.

Report on Heavy-Oil Engine Working Costs, 1949-50. Diesel Engine Users Assoc. At Caxton Hall, London, S.W.1, 2.30 p.m., December 13.

Inhibited Transformer Oil. W. R. Stoker and C. N. Thompson. **The Stability of Oil in Transformers.** P. W. L. Gossling and L. H. Welch. Institution of Electrical Engineers. At Savoy Place, London, W.C.2, 5.30 p.m. (*tea 5 p.m.*), December 19.

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The Director of Research of the Research Council of Alberta states, in his report for 1950, that co-operative experiments have demonstrated the feasibility of using the wet crude oil from the hot-water separation process as feed stock for fluidized bed cracking. S. M. Blair has recommended that combination and has reported that economic development of the sand is immediately practicable.

Fuller details of the proposals are given in the report (No. 60) which is obtainable from the King's Printer at Edmonton, price being 5 cents.

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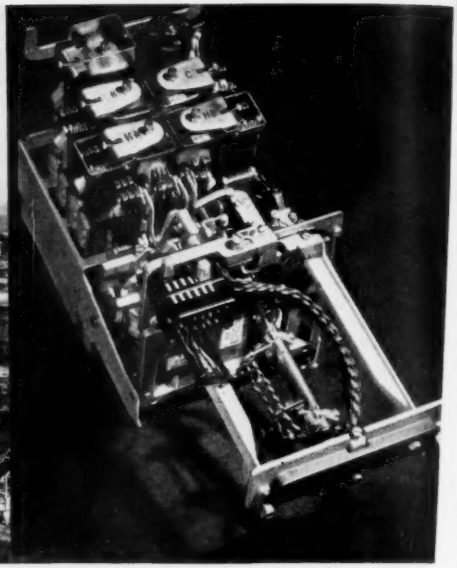

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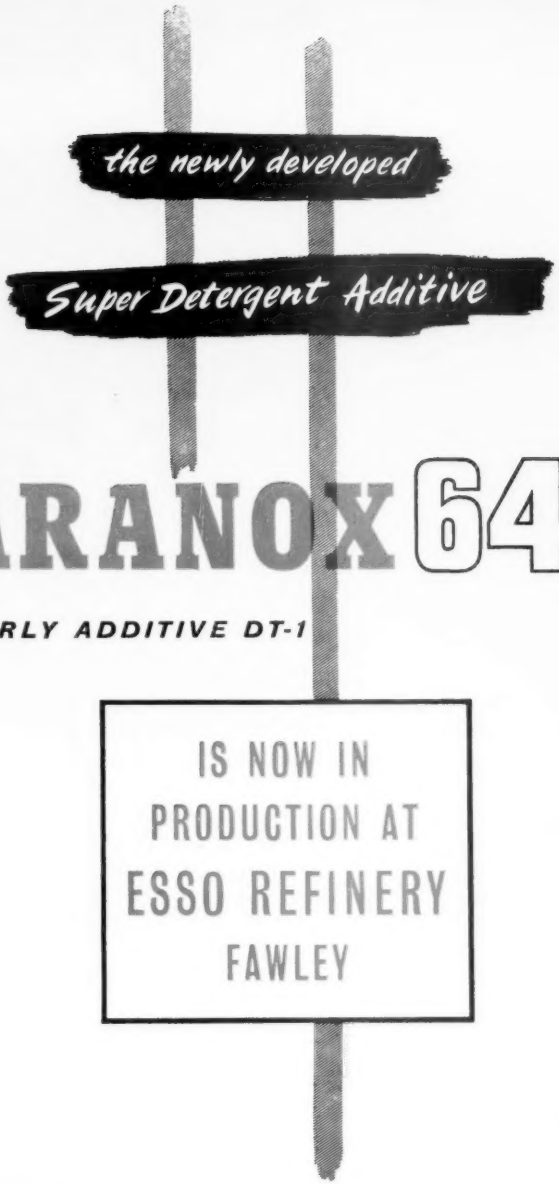

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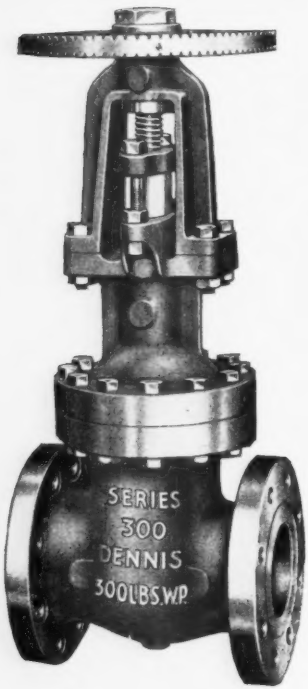

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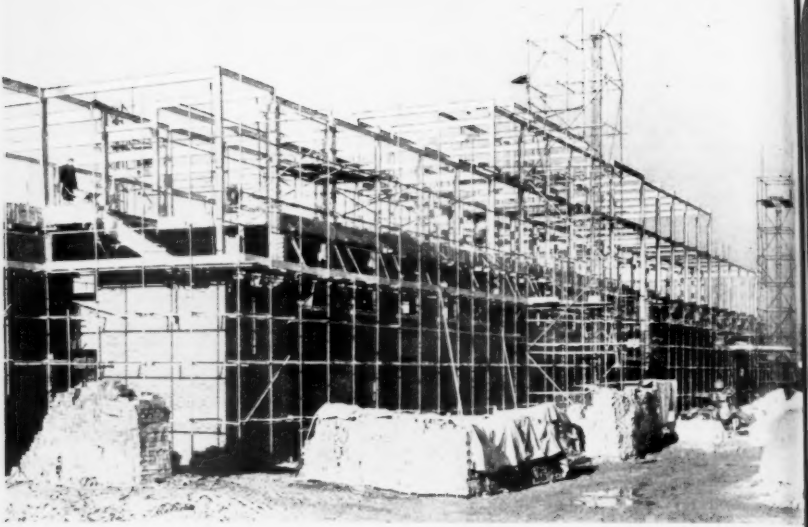

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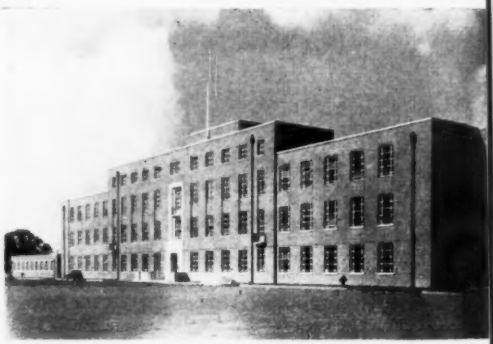

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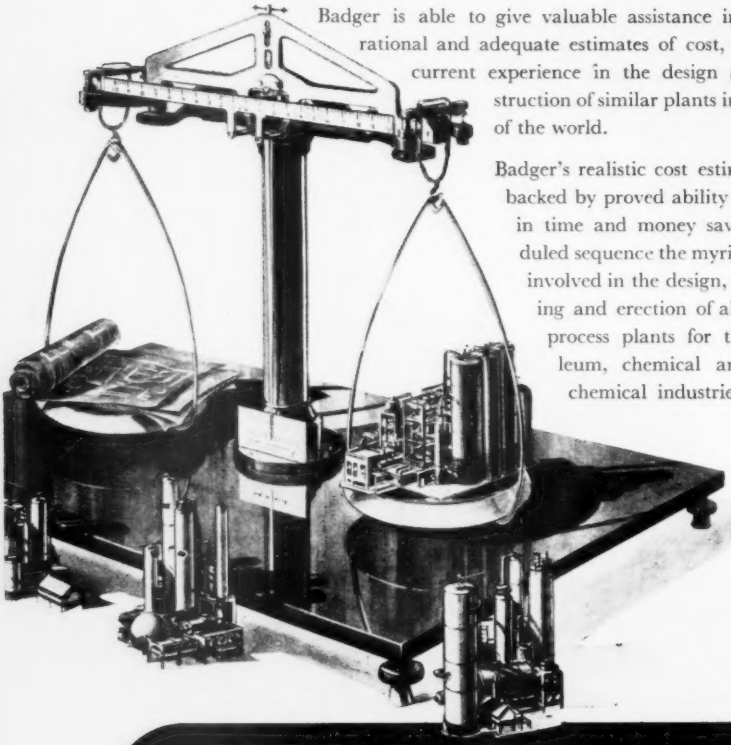

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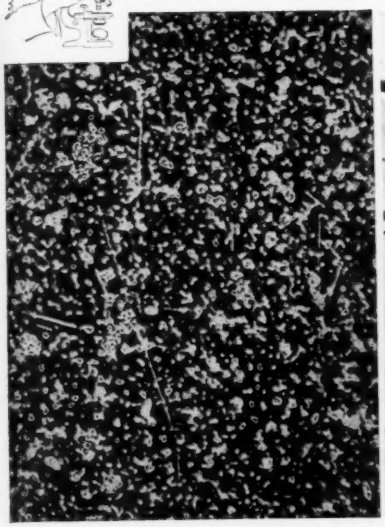

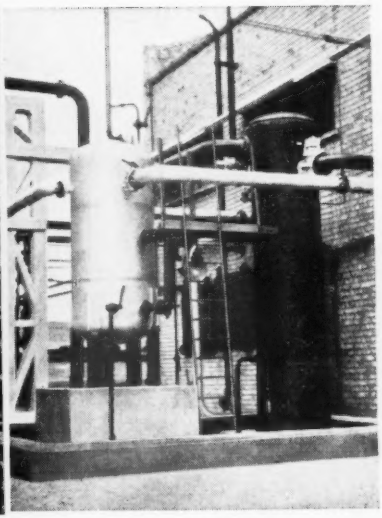

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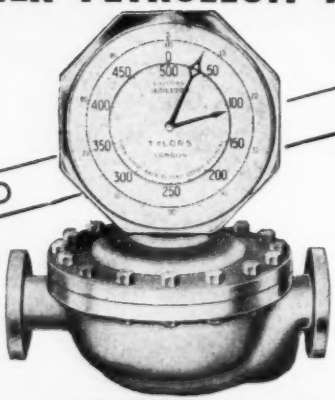

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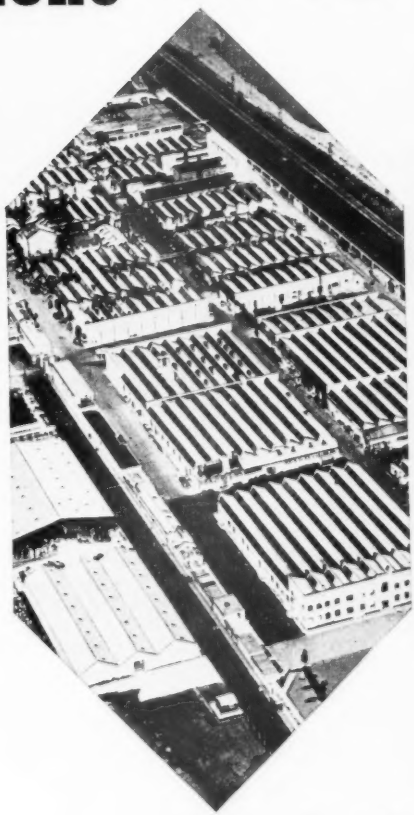

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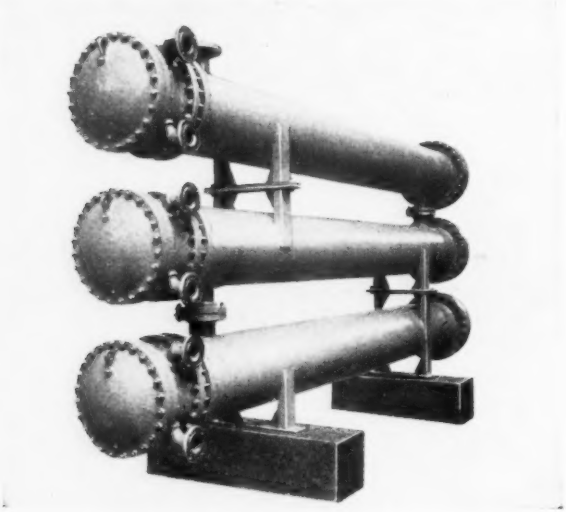

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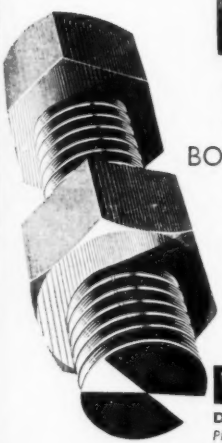

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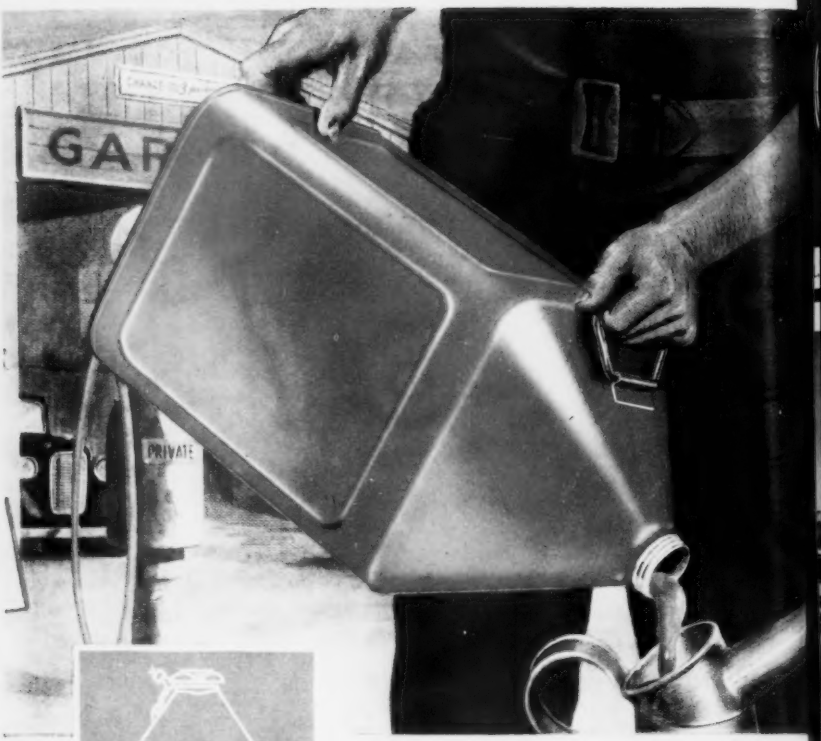

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